

OKEANOS EXPLORER

America's Ship For Ocean Exploration

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION • UNITED STATES DEPARTMENT OF COMMERCE



Exploring Our Ocean World

for the benefit of NOAA and the Nation

The ocean covers 70 percent of the Earth's surface and provides half the oxygen we breathe. It regulates the planet's temperature and provides recreation, food, a growing number of medicines and lines of communication for ocean commerce. The ocean is also central to the complex systems that control our weather and climate. Yet, despite the ocean's vastness and importance, it is 95 percent unexplored.

Explorer Robert Ballard has long had the vision of telepresence-enabled ocean expeditions, with technology bringing live images from the seafloor to scientists and other audiences ashore. NOAA's ocean exploration team worked with Dr. Ballard to test and advance telepresence technology that connects ocean expeditions live to audiences ashore via satellite and high-speed Internet pathways. It is a new model of exploring the ocean and NOAA Ship *Okeanos Explorer* along with Dr. Ballard's Exploration Vessel *Nautilus*, sail at the leading edge of this ocean exploration technology.



NOAA Ship *Okeanos Explorer* is the only federal ship to systematically explore the ocean.

Accomplishments

2011 Field Season - With the Bureau of Ocean Energy Management, *Okeanos* mapped several mid-Atlantic Canyons and conducted a pilot study in the Gulf of Mexico that demonstrated the capability of *Okeanos'* multibeam sonar to detect and map gaseous seeps in the water column.

An expedition to the Galapagos area discovered a new vent field. One species of tubeworms had never before been observed in the Galapagos. A Mid-Cayman Rise Expedition in partnership with NASA and NSF saw major discoveries including two species of marine life scientists believe have never before been seen together at a hydrothermal vent - chemosynthetic shrimp and tubeworms. Explorers also observed the first known live tubeworms ever seen at a hydrothermal vent in Atlantic waters. NSF plans more expeditions based on data collected by *Okeanos Explorer*.

During major expeditions, scientists participated via telepresence from shore at Exploration Command Centers at NOAA in Seattle, URI's Inner Space Center, and in Woods Hole Massachusetts, California, Pennsylvania, Germany, Canada, Portugal and the United Kingdom, some on computers in hotels, airports, offices and homes and most commenting on what they saw on an online chat room.

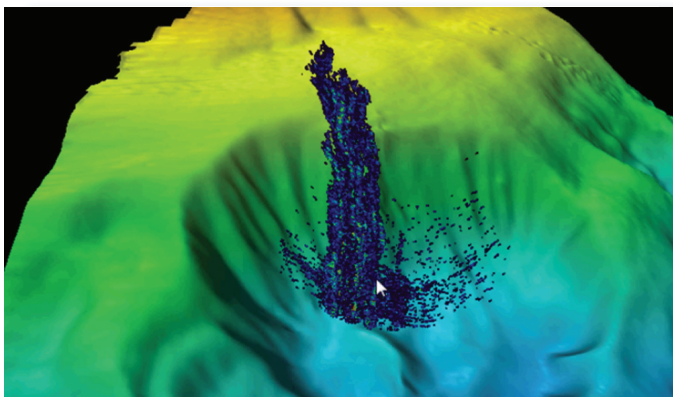
Okeanos mapped large portions of federal waters for a National Marine Sanctuary's boundary delineation and management. This was estimated to save the Sanctuary \$500K and five years of effort.

A benthopelagic sea cucumber swimming in the near freezing waters of the abyss, about 3200 meters deep. (right)



A deep-sea chimaera imaged by the IFE's Little Hercules ROV operating from *Okeanos Explorer* during the US-Indonesia joint ocean expedition. (left)





Data from *Okeanos*' state-of-the-art multibeam sonar produced this image of a plume of possibly methane gas, 1,400 meters high in the water column off Cape Mendocino, California.

NOAA outfitted its dedicated ship of exploration with the equipment, systems, and personnel to share the excitement of discovery and ocean science with students, teachers, scientists, and the general public. *Okeanos Explorer* is equipped for three primary mission capabilities: (1) deep-water mapping (2) science class remotely-operated vehicle (ROV) operations and (3) real-time broadband satellite transmission of data ashore, all to support the mission of systematic telepresence-enabled exploration.

The hub for technology ashore is the Inner Space Center (ISC) at the University of Rhode Island Graduate School of Oceanography. The ISC hosts one of a growing number of Exploration Command Centers ashore where scientists are on watch or on call, adding intellectual capital to ocean expeditions.

The ship's hull-mounted multibeam sonar system produces high-resolution maps of the seafloor and of material in the water column. If maps or other data show anomalies, the ship may stop and deploy systems including remotely-operated vehicles (ROVs). When enough data is collected to energize ocean researchers to conduct follow-on cruises, *Okeanos Explorer* moves on to explore other parts of the ocean.



The control room on NOAA Ship *Okeanos Explorer*.



Riftia tubeworms at a hydrothermal vent imaged during the 2011 Galapagos Rift Expedition.

2010 Field Season - Following a joint U.S.-Indonesia ocean expedition, Indonesia's ambassador to the U.S. Dino Djalal stated, "I cannot find a better example of how the 'Indonesia-U.S. Comprehensive Partnership' is being executed in terms of the soft power relationship than the present scientific cooperation of INDEX-SATAL 2010." Scientists observed possibly 40 new species of deep-sea corals and 50 new species of other animals.

NOAA's ocean exploration team partnered with NOAA's Fisheries Service to conduct sampling over the Pacific Ocean 'Garbage Patch' and collected more than 5000nm worth of continuous plankton recorder transects. Eleven previously unmapped seamounts were mapped between Hawaii and California, three of which were not known based on existing available data.

2008-09 Field trials - The *Okeanos*' multibeam mapped priority areas in support of National Marine Sanctuaries, including a large portion of Olympic Coast NMS, 35% of Cordell Bank NMS and 7% of the Gulf of the Farallones NMS. Also included 91% and 31% respectively, of the CBNMS and GFNMS proposed expansion areas and priority areas identified by Papahānāmokuākea Marine National Monument. Six seamounts off the western Hawaiian Islands were mapped, and several impressive, 1400 meter-high gaseous plumes were discovered and mapped off the coast of California.

Across its three field seasons, the ship's expeditions provided vital information and discoveries that were shared with ocean resource managers, other federal agencies, state and local officials, academic institutions, industry leaders, schools, museums and the public through state of art telepresence systems, websites and data portals.

In three field seasons (2009-2011), the *Okeanos* mapped in high resolution 462,719 sq km of unmapped or poorly mapped seafloor, an area about equivalent to the state of California; conducted 67 dual-vehicle ROV dives, exploring the seafloor with high resolution video cameras; discovered several unknown seamounts; characterized critical habitat areas for National Marine Sanctuaries; provided data in support of the U.S. State Department-led Extended Continental Shelf (ECS) project; trained 40 undergraduate and graduate students on board and ashore, and many more students via telepresence.

The *Okeanos Explorer* Education Materials Collections *Why do we explore?* and *How do we explore?* support Science, Technology, Engineering and Mathematics (STEM) and focus on the importance, techniques and tools of ocean exploration. These collections have been shared with nearly 2,000 teachers during on site and online professional development institutes.